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Abstract

How do banks design mortgage modifications when under regulatory expectation to issue them widely and quickly? Who do they allocate modifications to, and how deep are repayment cuts? How many modified loans end up re-defaulting? A large-scale Irish program allows us to tackle these questions using household- and loan-level data from 2012 to 2016. We show that the issuance of permanent modifications is not uniform across the credit risk distribution: those with a moderate ability to repay are more likely to receive a modification than those in deepest financial difficulty. Repayment cuts however are more generous as repayment capacity weakens, as long as borrowers have some surplus income available to service debt. Finally, deeper repayment cuts and lower payment-to-income ratios lower re-default rates, confirming prior evidence on the importance of liquidity for mortgage distress.

Keywords: Mortgage Default; Mortgage Modification
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Non-Technical Summary

How do banks respond when given discretion on how to implement a modification program that may have wider socioeconomic implications? Does their response align with profit-maximising behaviour, and might this diverge from the will of policymakers?

The Irish policy response to the 2008 global financial crisis offers an ideal setting to study these questions. The crisis caused widespread payment distress among owner-occupier mortgages, with close to one-fifth of mortgages being in arrears at the peak. The socio-political environment around the time of the crisis and subsequent bailout of banks meant that the overarching policy response to the crisis favoured the retention of homeownership, with home repossession only to be pursued as a last resort. After a number of years of short-term, often unsuccessful forbearance practices in the face of deep insolvency for many borrowers, the Central Bank of Ireland set expectations for private banks (some of which were fully or partly owned by the government through recapitalization packages) to implement long-term, sustainable, mortgage modifications in 2013.

While expected to rapidly modify large shares of their distressed mortgages, Irish banks were given full discretion on how this was achieved: there were no specific targets for outcomes such as borrowers' debt service ratios, or the precise modification type that had to be offered. Rather, the Central Bank of Ireland's Mortgage Arrears Resolution Targets (MART) program required that banks could verify that the modification was sustainable, given the borrower's circumstances. Importantly, both from the perspective of the literature on mortgage modifications following the United States mortgage crisis, and our own research agenda, Irish banks were armed with close-to-perfect information with which to assess distressed borrowers' financial health, through the requirement that all borrowers complete a Standard Financial Statement as part of the renegotiation process.

Using this unique household balance sheet data collected at the point of debt renegotiation between 2012 and 2016, combined with supervisory loan level data, we study three topics: (1) which borrowers are issued modifications? (extensive margin); (2) which borrowers receive deeper cuts to repayment during the modification process (intensive margin) (3) what are the predictors of re-default?

On the extensive margin, we estimate the probability of receiving modifications among those engaging with the renegotiation process between 2012 and 2016 in the Republic of Ireland. We show that borrowers with weaker repayment capacity are more likely to receive short-term modifications. However, where longer-term, sustainable arrangements are concerned, the relationship is not linear: those with the weakest repayment capacity are less likely to receive a modification than those with a moderate level of repayment capacity. Those with higher loan to value ratios (LTV), implying weaker housing equity positions, are also shown to be less likely to receive modifications. Our extensive margin findings suggest

that banks do not necessarily allocate modifications as a function of financial need, and that gaps may emerge where, in line with prudent credit risk management, those in the most challenged financial position are not the most likely to be modified. From a wider government policy perspective, this highlights that policy implemented through the banking system may need to be complemented with social policies that arrive at solutions for those in most need.

On the intensive margin, we show that those with the weakest repayment capacity received deeper cuts in their payment obligations. This holds across modification types, but is shown to be strongest for long-term modifications, and stronger after the Central Bank implemented the MART program in 2013. Contrary to the ambiguous nature of the findings on the extensive margin, these findings suggest that banks do indeed target deeper payment relief to those that need it most.

Finally, we turn to the probability of re-default in the months after a modification has been issued. We show that, as is the case in the literature on mortgage default more generally, both liquidity and housing equity factors matter. Households with lower payment-to-income ratios, and lower loan-to- value ratios after the modification has been issued have a lower probability of re-default. These effects are also shown to interact, with weaker liquidity being more damaging when equity is also weaker, in a classic ”double trigger” mechanism.

We contribute to debates around the frictions inherent in policy programs implemented through the banking sector. There are major advantages to such an approach, given the benefits that come from the existing expertise, information, and relationship networks possessed by banks. However, a useful starting point for assessing such program implementation issues is that private entities are unlikely to, and cannot be expected to, have the same set of goals as a social policy maker. With this in mind, ancillary programs or links to other elements of the social safety net may be important in achieving wider social welfare goals, for example in cases where borrowers with the weakest repayment capacity are not selected by lenders for modification.

1 Introduction

Distressed mortgages present immense challenges for policymakers. While bank balance sheet clean-up is a priority in the aftermath of all financial crises, preferences for homeownership makes debt resolution particularly complex in the owner-occupied mortgage market. Aside from obvious social and personal costs, rapid and widespread foreclosures are undesirable due to the prospect of fire sale externalities, which can exacerbate downturns by hurting aggregate demand and banks balance sheets further. The literature has identified many frictions that can limit the use of mortgage modifications as an alternative debt resolution strategy (e.g. building operational capacity[1], coordinating different interests[2], and identifying borrowers who truly need debt relief[3]).

In this paper, we assess the allocation and efficiency of modifications when the usual frictions are removed and banks retain responsibility for designing modifications. We study a large-scale modification program that took place during the 2012-2016 mortgage arrears crisis in the Republic of Ireland. We document who banks allocated modifications to (extensive margin), how deep repayment cuts were (intensive margins), and evaluate the performance of modified loans. The analysis provides insights as to whether modifications programs are a reliable balance sheet repair strategy, as well as assessing whether they provide relief to the most vulnerable borrowers.

Four features of the Irish mortgage market during the last crisis make it the ideal setting for studying how modifications are issued. Firstly, during the crisis, owing to uncertainty within the legal system and a socio-political environment favouring homeownership, the ultimate threat of home repossession was remote in most mortgage arrears cases. Banks operated in a system where it was explicit that modification was favoured. Secondly, borrowers signalled their willingness to modify by filling out a Standard Financial Statement (SFS). Originally introduced in 2011, the SFS stemmed from a recommendation at the time from the Government Expert Group on Mortgage Arrears and Personal Debt and was jointly developed and agreed by the Money Advice and Budgeting Service (MABS), the Irish Banking Federation (IBF) and the Central Bank. The SFS form records full income, expenditure, demographic and balance

[1] Agarwal et al. (2018a) find that while HAMP did increase modifications, it fell short of its target because it did not provide sufficient monetary incentives to overcome institutional frictions. For example, banks with low prior expertise in renegotiation may require large financial incentives to hire lawyers and recruit trained resolution professionals, rather than resorting to foreclosure to resolve non-performing loans.

[2] Agarwal et al. (2011) and Geanakoplos and Koniak (2008) show securitization can hinder modifications. But Adelino et al. (2014), focusing on early-default loans, shows securitized mortgages are actually more likely to be modified and less likely to be foreclosed on. And Adelino et al. (2013) documents similar renegotiation rates across securitized and retained mortgage portfolios.

[3] Adelino et al. (2013) show information asymmetries introduce barriers to effective renegotiation of delinquent loans. High-self cure rates and high re-default risk makes foreclosure the optimal strategy.

sheet current information. These SFS provide lenders with close to full information on which to assess repayment capacity of borrowers engaging with the modification process, substantially eroding the information asymmetries proposed as an explanation for low modification rates in the USA by Adelino et al. (2013). Thirdly, lenders were incentivised through provisioning charges by their regulator, who specified that banks were to issue modifications to the majority of their distressed mortgage portfolio within a fixed period of time, beginning in 2013, as part of the Mortgage Arrears Resolution Targets (MART) program (Central Bank of Ireland, 2013b).

Fourthly, while lenders were incentivised to issue long-term sustainable modifications to a large cohort of borrowers from 2013, unlike the HAMP program in the USA, there was no guidance given on the *type* or *depth* of modifications issued. Lenders had to put borrowers' finances on a loosely defined sustainable long-term footing. They had discretion over (a) whether to offer a modification, (b) the type of modification, and (c) the depth of repayment cut.

This environment allowed for modifications on a remarkable scale. In the Irish owner-occupier mortgage market, the share of mortgage accounts with some form of modification rose from 8 per cent in 2010 to 16 per cent in 2016. This occurred in a context of widespread mortgage payment distress, with the share of loans in arrears peaking at 18.5 per cent in mid-2013.

Our first set of empirical results focuses on who lenders issue mortgage modifications to, conditional on the borrowers having engaged in the modification process (filling out an SFS). Lenders can extend temporary or permanent modifications. With information on current income, family structure and indebtedness at the point of borrower engagement, SFS data measure the precise amount that borrowers have available to service mortgage debt.[4] We summarize borrowers' ability to repay by the ratio of Residual Income (income net of non-housing expenditure and non-mortgage debt repayments) to Mortgage Repayment (RIMR).

We find the issuance of modifications is not uniform across the credit risk distribution: the probability that *permanent* modifications are issued is non-linear in households' ability to repay. At all levels of residual income below zero, the probability of modification is constant. Above zero, i.e. where borrowers have *some amount* of income remaining to service debt (up to 50 per cent of the ex-ante mortgage repayment), there is an extremely strong positive relationship between residual income and the probability of a permanent modification. When

[4] HAMP required borrowers to disclose only income data (tax returns, pays stubs or equivalent documents) (Treasury, 2009).

residual income becomes higher than 50 per cent of the ex-ante mortgage repayment, the likelihood of a permanent modification levels off.

We also observe the issuance of temporary modifications such as fixed-duration Interest Only (IO) periods. Contrary to *permanent* modifications, greater pre-modification financial health linearly lowers the likelihood of a *temporary* modification.

We look at the depth of repayment cuts in our second set of empirical results. Again, borrowers' ability to repay is a key determinant of how generous modifications turn out to be (as a share of the pre-modification payment). A one-standard-deviation fall in RIMR leads to a 35 per cent greater cut in monthly repayments, controlling for borrower and loan characteristics. Conditional on receiving a modification, as repayment capacity is weaker, the bank offers greater repayment relief. These effects are stronger for permanent than for temporary modifications, and were stronger after the introduction of the MART program than before. We also document important non-linearities, with the elasticity of banks' repayment cuts to borrowers' repayment capacity being extremely high in an intermediate range of repayment capacity, and close to zero for engaged borrowers with very high or very low RIMR.

Importantly, we show that the effects of more generous modifications do not reverse the pre-modification ranking of repayment burdens. Despite those with lower RIMR receiving greater repayment cuts, we show that these borrowers have higher post-modification payment-to-income ratios.

Our final set of empirical models focuses on the performance of modifications. We analyze the probability of distress (either new arrears or new modification) within six months of the issuance of a modification. Over this timeframe, 80% of permanently modified loans keep making payments. We show that higher levels of payment-to-income ratios drive failure rates up, consistent with a number of studies on the importance of liquidity in the success of mortgage modifications (Ganong and Noel, 2018). Setting payment-to-income ratios 10 percentage points higher increases the quarterly failure rate by 0.8 percentage point. Post-modification changes to payment-to-income ratios (e.g. driven by rates changes) also dramatically increase failure rates. Borrowers whose PTI increases by 10 percentage point during the lifetime of the modification are 17 percentage points more likely to fail.

Our results, while focusing primarily on a precisely-measured gauge of repayment capacity, are also informative in the context of wider debates on the relevance of liquidity and equity forces in explaining mortgage distress. In our extensive margin models, loan-to-value

(LTV) ratios are important in deciding who gets a modification, with higher LTV loans less likely to be modified. However, conditional on receiving a modification, lenders' choice of repayment cut is not sensitive to the borrower's LTV position, implying banks do not take housing equity into account when deciding on the intensive margin. In all our failure models, the positive effect of higher LTVs is robust and statistically significant, and in some cases is shown to interact with PTI ratios, in line with double-trigger models of mortgage default (Gerardi et al., 2017).

Our research contributes to the mortgage modification literature, which has focused almost exclusively on the United States up to now. We document modification taking off as a relevant debt resolution strategy when information asymmetries are alleviated. This is consistent with Adelino et al. (2013) findings that renegotiation rates are negatively correlated with the degree of informational asymmetries between borrowers and lenders.

We also find that payment to income ratios are the main driver of modifications' performance. This is consistent with the evidence in Ganong and Noel (2020) that liquidity drives default. They show principal reductions increasing housing wealth without affecting liquidity are ineffective. But maturity extensions increasing only liquidity improve re-default and consumption outcomes. Calem et al. (2018) also note that larger payment reductions are key for successful modifications. They document a larger decline in re-default rates for modified loans than for similarly situated self-cured loans.

Consistent with policy messages consistently delivered by the Central Bank of Ireland since the last crisis, we highlight that permanent, or long-term, modifications, have substantially higher success rates than temporary arrangements. This is particularly true during a crisis such as that in Ireland after the 2008 crash, where borrower income shocks were deep and long-lasting, and negative equity was widespread. Ultimately, despite appearing more costly up-front, these arrangements that adequately tackle repayment capacity are in the best interests of both borrower and lender.

The COVID-19 pandemic has further highlighted the importance of understanding the potential for frictions and design issues in the issuance of mortgage modifications. Across the globe, loan moratorium programs were put in place to allow borrowers temporary relief from the initial liquidity shock cause by public health restrictions. In late 2020 and early 2021, these moratoria have begun to expire, with many borrowers potentially needing additional modification or forbearance as the effects of the pandemic continue to cause repayment difficulties. Our results on the way in which Irish banks issued widespread modifications across

borrower types, as well as on the causes of re-default, are relevant to those charged with designing policy interventions to assist borrowers after the expiry of these moratorium programs.

Finally, our work has relevance to debates on the frictions inherent when financial intermediaries are involved in elements of public policy implementation. Recent research on the COVID-19 pandemic has shown that the banking system introduced substantial frictions when intermediating emergency government funds to businesses in the United States through the Payment Protection Program (PPP). Balyuk et al. (2020) show that larger banks favoured larger corporate clients in the rapid delivery of emergency funding, while Li and Strahan (2020) show that traditional relationship banking effects meant that those without pre-existing relationships with participating banks were less likely to receive PPP funding. Agarwal et al. (2018b) show that, in a monetary policy expansion, banks pass through the largest benefit to those borrowers with the weakest marginal propensity to borrow, while those with the greatest borrowing needs receive the weakest pass-through due to bank risk appetite. While mortgage modification was not an government-led public policy in the Republic of Ireland during the period under study, the discretion allowed to banks to allocate modifications allows lessons to be drawn.

From a distributional perspective, our results are mixed, but imply in a number of places that banks issued modifications consistent with progressive policy goals. We find that lenders do not target a unique post-modification payment-to-income ratio but that repayment cuts are more generous as repayment capacity weakens. This yields a wide range of post-modification payment-to-income ratios. This is consequential as we find the post-modification liquidity position to be highly predictive of modification performance. Similarly on the extensive margin for temporary modifications, these short term relief measures are offered more readily to those with weaker repayment capacity.

However, for longer-term permanent arrangements, those with the weakest repayment capacity have the lowest probability of being modified. On this dimension, our findings are more similar to those mentioned above, that the prudent decision making and operational or informational frictions in the banking sector mean that policy aims are distorted through the prism of the financial intermediary.[5]

[5]Our discussion here can only indicate directionally at the relevance of our results for discussions of policy effectiveness. Ultimately an analysis of the degree to which banks arrive at modification allocation decisions that are optimal from a wider welfare perspective is beyond the scope of the paper. It would require the researcher to specify a social welfare function with weighting for different borrower types. It would also require understanding the cost of those modifications to lenders and whether they have significant impacts on the supply of credit via a capital channel.

The rest of the paper is organized as follows. Section 2 frames the institutional context and details data used. Section 3 focuses on the extensive margin of modifications while Section 4 analyses their extensive margin. Section 5 adopts a performance perspective and analyzes re-default rates. Section 6 concludes.

2 Data

2.1 Institutional Set-Up

The mortgage arrears crisis in Ireland arose as a direct consequence of a credit-fuelled housing market boom which peaked in 2007/2008. Starting in the early 2000s, the Irish mortgage market was subject to ever-rising origination loan-to-value and loan-to-income ratios, loosening underwriting criteria, new competitor entry, and resultant double-digit house price growth.[6] Fiscal policy contributed to loose market conditions, with tax deductions for mortgage interest payments and incentives for buy-to-let investment and construction activity. The collapse in this mortgage and housing bubble was dramatic: between 2008 and 2013 mortgage arrears rates rose to close to 20 per cent, while property prices fell by between 50 and 60 per cent.

There was a high degree of coordination in the policy response to this crisis between the Irish government (as owner of a number of the main retail banks following a 2011 capital injection and nationalisation), the central bank (as financial regulator) and the banks themselves. The IMF, ECB, and EU Commission facilitated and enabled the Financial Measures Program (FMP, 2011-2014), which oversaw the bailout both of the sovereign and the banking sectors. Due to a wide range of factors, the retention of homeownership was a central feature of the government policy response to the crisis. Minister for Finance Noonan is quoted as saying, at the publication of the "Keane Report" in 2011, that "the primary principle is that people continue to live in their own homes. And the second issue is there must be a clear distinction made between those who can't pay and those who won't pay."[7] This meant that mortgage modification, rather than foreclosure or sale or transfer to other servicers, was the primary tool available to the retail banks in Ireland in responding to the crisis.

Early in the crisis, the regulator observed that banks were over-reliant on temporary modifications, such as interest-only periods, temporary payment moratoria or temporary reduc-

[6] The origins of the Irish financial crisis have been summarized in a range of parliamentary reports, books and other publications. See for example Lane (2011) and Honohan (2019).

[7] For an example of reporting of the Keane Report, see here.

tions in interest rates.[8] They were often insufficient to resolve the deep negative equity and illiquidity that were facing many mortgage borrowers. This created regulatory concerns about the potentially weak level of loss provisioning on defaulted mortgages.

As a response to these concerns, the Central Bank of Ireland launched the Mortgage Arrears Resolution Targets (MART) program in 2013. The Central Bank's insisted that over a two-year horizon, over eighty per cent of all impaired mortgages were to be issued a "sustainable solution" (Central Bank of Ireland, 2013b). Concurrent with being compelled to engage in rapid and widespread issuance of sustainable modification, banks were given full discretion on how to design them. Contrary to the HAMP program in the USA, with specific ex-post debt service targets, no guidance on the *type and depth* of modification was issued. Lenders issued a wide range of modifications, with the three most common long-term arrangements being Arrears Capitalization (AC), Term Extension (TE) and Split Mortgages (SM). An AC involves the addition of arrears balances to the total amount outstanding, so that arrears are re-set to zero, with an increase in contracted payments often resulting. A TE can be combined with an AC, which allows a borrower to clear arrears without increasing contracted payments. Finally, an SM is equivalent to a "principal forbearance" product in other jurisdictions, where the loan is split in two, with one portion serviceable monthly under traditional amortizing terms, while a second loan (the "warehouse") falls due at loan maturity.[9]

The provisioning treatment under the MART program removed any incentive that banks may have had to dis-engage with borrowers, avoiding the acknowledgment of the true repayment capacity of borrowers. In a hypothetical system of lax supervision, banks may have incentives to delay loss recognition and preserve potentially scarce capital, especially during a recession. The Central Bank's approach ensured that borrowers' engagement with the system of mortgage modification was a sufficient trigger for mortgage impairment.[10] As soon as the borrower engages in the modification process, the bank has to review the loan and provision for it, as engagement is a sign of a higher probability of default. This automatically resets the value of the loan on the lender's balance sheet to the maximum loan affordable to the engaged borrower. Once this provision has been taken, actually extending a modification has no additional cost, thereby reducing greatly the potential for another friction to hold back modification issuance.

[8] Donnery et al. (2018) and McCann and O'Malley (2020) outline the crisis response and key policy issues.

[9] We will refer to arrears capitalization, term extension, and split mortgages as permanent modifications in the remainder of the paper. We refer to interest-only periods, temporary payment moratoria, and temporary reduction in rates as temporary modifications.

[10] As per the Central Bank of Ireland's provisioning guidelines (Central Bank of Ireland, 2013a): "The Central Bank considers that the request for a forbearance measure from a borrower is an impairment trigger. Accordingly, such exposures should be reviewed for impairment on a specific or collective basis as appropriate.

The introduction of the industry-wide Standard Financial Statement (SFS) largely overcomes information asymmetry challenges.[11] The SFS was agreed in 2011 as the basis under which lenders would make mortgage modification decisions[12], and collects up-to-date information on borrower finances, including current income, employment, family circumstances, non-mortgage debts and expenditure levels on non-housing items. This is a requirement under MART. Armed with this information set, lenders can make close-to-perfect assessments of the monthly repayments that each household can service.

2.2 Households' Balance Sheets

The Standard Financial Statement (SFS) was created in 2011 to ensure a consistent basis across the financial sector for the collection of distressed borrower information (see Central Bank of Ireland (2011)). Any borrower in financial difficulty seeking an amendment to their mortgage contract must file one. SFS data provide a detailed account of borrowers' household positions at the point of engagement with their lender. Households are requested to provide any documentation the lender requires to ensure accuracy of the data.[13]

Our database contains SFS entries completed from 2012 onward. Data collected in the SFS are categorised as follows: current monthly income; monthly itemized household expenditure; current monthly debt payments on both mortgage and non-mortgage debts; property assets (other than primary residence); non-property assets; and demographic characteristics of the household. This allows us to create a profile of household financial distress that is extremely rare in the literature.

Widespread borrower engagement was already underway in 2012, when we observe the largest amount of SFS submissions. A household can engage more than once in the SFS process. For example, where financial circumstances have changed, or if a modification is not successful and requires further assessment and restructuring, a repeat SFS may be required. For other modification types, regular reviews may be expected and require subsequent SFS submissions. Over thirty thousand households have submitted a single file. Just over twenty thousand households have submitted two files, with over ten thousand submitting three times.

[11] Adelino et al. (2014) shows that banks under-issue modifications under asymmetric information for fear of confusing can-pay and can't-pay borrowers.

[12] There was no significant operational capacity and processes to handle modification requests pre-crisis as default rates were low.

[13] The consumer guide to the SFS includes a 3-page long documents checklist, listing statements of mortgage payments, recent payslips, utility bills, and proof of maintenance payments among other possibilities (Central Bank of Ireland, 2011).

The median borrowing household income in our sample is about €2,600 a month or €31,200 a year after tax (Table 1). The distribution of annualised household income has a mode just short of €10,000, which represents 52 weeks at the Irish social welfare level of €188 per week (Fig. 1). By way of comparison, average household income among new Irish mortgage borrowers was €75k for first-time buyers and €113k for movers in 2019 (Central Bank of Ireland, 2019).

Many borrowers have already reduced non-housing expenditures to basic levels when engaging with the mortgage renegotiation process. Figure 2 compares households' reported expenditures to their reasonable living expenditure (RLE). The RLE is defined by the Insolvency Service of Ireland and is encouraged as a guideline to be used by lenders when calculating serviceable debt amounts. The RLE amount for a household depends on the number of adults and children, along with whether or not a car is used (Insolvency Services of Ireland, 2012). Self-reported expenditures are strikingly close to RLEs, even though the later are intended as a a *lower* bound on non-mortgage expenditures. Households below the 45 degree line are already spending less than their implied RLE when engaging. For this large group, there is no adjustment in living standards available to improve debt service capacity, if one is to take the RLE as an absolute minimum amount of non-housing expenditure. In the language of Gerardi et al. (2017), many borrowers in our data can be described as being in a can't pay position before mortgage renegotiation.

Even with expenditures close to minimum reasonable expenses, engaged borrowers face liquidity issues. Every month, non-housing expenditures plus mortgage and other debt payments are €751 (€640) higher than income for the average (median) borrower in the SFS sample. We refer to this amount (income minus non-housing expenditures, mortgage, and other debt payments) as the borrower's surplus.

Borrowers facing the most acute liquidity issues (smallest surplus) have bigger shares of non-mortgage debts in total outgoings, at close to 15 per cent. Among those with the largest deficits, non-housing expenditures and mortgage payments account for close to 100 per cent of income on average, while other debt payments are close to half of income. As we move towards households in better financial health, ratios of all types of expenditures to income fall. Among the top twenty per cent of SFS-submitting households (ranked by surplus), income is sufficient at the time of engagement to meet all contracted debt repayments and reported expenditures.

To measure how much mortgage payments have to be adjusted for borrowers to be able to meet their obligations, we build an ability to repay measure. We compute the residual income to mortgage ratio (RIMR) as:

$$\text{RIMR} = \frac{\text{Income} - \text{Non-Housing Expenditures} - \text{Non-Mortgage Debt}}{\text{Contracted Mortgage Payment}} \tag{1}$$

where Income is reported net monthly household income, Non-Housing Expenditures is reported monthly expenditure on non-housing items, Non-Mortgage Debt is non-mortgage payments due at the date of SFS completion (before modification). Contracted Mortgage Payment is the amortizing payment contracted pre-engagement in the modification process. It is common that borrowers cannot meet any mortgage obligation after their expenditures and non-mortgage debt payments have been deducted from their income (i.e. the range where $RIMR$ is negative in Fig. 3a).

The average residual income rose from 20% of the contracted mortgage payment in 2012 to 60% mid-2015 (Fig. 3b). This is consistent with the significant recovery of the Irish economy after it reached peak unemployment levels in 2013, but given the pooled cross-sectional nature of our SFS data, may also be explained by a changing composition of borrowers engaging with the renegotiation process.

2.3 Mortgage Data

We extract data on mortgages from the Central Bank of Ireland's mortgage Loan Level Data (LLD). The data were first collected in early 2011 as part of the Prudential Capital Assessment Review (PCAR). This assessment of bank solvency ultimately resulted in State financial support being provided to six domestic Irish banks in the guise of the Financial Measures Programme (FMP). Of these six banks, four remained as going concerns at the end of the programme: Allied Irish Banks (AIB), EBS, Bank of Ireland (BOI) and Permanent TSB (PTSB), with EBS being subsumed into the AIB group.

Information on each loan outstanding at December 2010 at the subject banks was provided as part of PCAR, with historic information on each loan's arrears balance going back for twelve months to December 2009 for two banks and going back further to June 2008 for one bank. After the PCAR, an additional dataset was provided pertaining to the December 2011 profile of all outstanding loans at the subject banks, with twelve months of arrears history to December 2010 provided.

Since December 2011, the Central Bank has received LLD every six months from these banks. From January 2015, KBC Ireland and Ulster Bank Ireland Limited (UBIL) began submitting LLD files for their Irish mortgage portfolios to the Central Bank, meaning that for the 2015 and 2016 versions of the LLD, the five main mortgage lenders comprising over 90 per cent of the Irish mortgage market are submitting loan-by-loan information.

The LLD contain information which is updated every six months on items such as a loan's current outstanding balance, interest rate, interest rate type, payment type, modification status, loan to value ratio (LTV) and loan maturity date. A wide range of time-invariant fields are also observable in the data (First Time Buyer status, Buy to Let status, drawn balance at origination, originating borrower income, originating LTV, borrower and collateral location, date of origination).

Our research will focus on a joined LLD-SFS panel dataset featuring all seven waves of the LLD from June 2012 to June 2015. We restrict our analysis to the three banks that submit SFS files consistently during this period (AIB-EBS, BOI, and PTSB). The SFS dataset is joined to the LLD at the date nearest to the submission of the SFS. For example, an SFS with a submission date of February 2015 is merged to the corresponding loan identified in the LLD December 2014 wave. We do not analyse data beyond the June 2015 wave of the LLD due to a change in the reporting of modification types in the LLD which makes consistent analysis impossible.

There are 74,180 mortgages in the LLD that are observed in the SFS, and can be merged for possible inclusion in our empirics. The panel has 600,077 observations, covering 485,155 unique mortgage loans. It is a highly balanced panel, with 462,008 observations accounted for by mortgages that appear seven times in the panel. The average loan in the merge dataset has a 193,000 EUR nominal balance and a 3.44% interest rate. The current LTV on these loans is high at around 100% (Table 1).

Figure 4 reports the 90-day arrears rate (default rate) in our LLD-SFS panel data, with delinquency peaking in late 2013 above 11 per cent and falling to 7 per cent by the end of the sample in mid-2015. Between June 2012 to June 2015, 15.4 per cent of mortgages have ever been delinquent. The total number of loans modified per quarter peaked at about 16,000 late 2012, and remained steady through 2013 and 2014 (Figure 5a). But permanent modifications had overtaken temporary ones by mid-2013, following the introduction of the MART program (Figure 5b).

One interesting element of the environment is that borrowers have an outside option of non-engagement. If borrowers do not engage with the SFS process, they can continue to miss payments, while having a low risk of loss of homeownership due to the aforementioned socio-political environment. These non-engagers are a concern from the point of view of a study like ours, in that they represent a selected group of borrowers who cannot be included due to their lack of filing an SFS. Previous research has highlighted that between a fifth and a third of borrowers in short-term arrears and 40 per cent of borrowers in long-term arrears were non-engaging in 2017, and having investigated the characteristics of non-engagers, found that they do not exhibit observable differences from those engaging (McCann, 2018). Our loan-level data, including both those that do and do not complete an SFS, also show that, despite this credible threat of non-engagement, the share of performing loans engaging over a year (3%) is three times as large as the share of performing loans defaulting (1%), suggesting borrowers try to signal their hardship before having to default. Further, 14% of the non-engaged defaulted borrowers engage within one year. This suggest borrowers do take up the opportunity to renegotiate, even in an environment with lower costs to default arising from legal and institutional factors.

3 Who Gets a Modification?

We start off modelling the extensive margin. Conditional on engagement (completion of an SFS form), what is the likelihood that borrowers receive a modification?

A hundred days after an SFS is completed, the probability that a mortgage has not received a modification (i.e. that it has "survived" unmodified in the language of the Cox model) is close to 60 per cent (Fig. 6a). One year after completion of an SFS, this probability is close to 40 per cent. As these survival curves do not approach zero, even over a long timeframe, the completion of an SFS does not automatically imply that loans will be modified. Banks use their discretion in assigning modifications across borrower types.[14]

Temporary and permanent modifications are issued on different timelines (Fig. 6b). At all time beyond one month post-SFS, the unconditional cumulative incidence is higher for temporary modifications, reflecting their widespread use in the Irish system. One year out from completion, between 25 and 30 per cent of SFS submissions have transitioned to each of our two modification types.

[14] Some borrowers might also reject an offer, and appear then as though "not allocated" a mod, but we think this is small feature.

Figure 7 plots the cumulative incidence curves separately by modification type and vintage. The effect of the 2013 MART intervention and the changing nature of mortgage distress is clearly visible along the left hand side, comparing the 2012 and 2014 cumulative incidence curves. In 2012, the likelihood of a *temporary* modification rises above 50 per cent within 150 days of completing an SFS, with the likelihood of a *permanent* modification remaining negligible. By contrast, just over a quarter of SFS have transitioned to a *permanent* modification within 180 days of completing an SFS in 2014, compared to a cumulative incidence rate of just over 12 per cent for *temporary* modifications over the same t.[15]

We formally assess the importance of loan and borrower profiles in the modification issuance decision in a Cox proportional hazards framework, allowing for multiple competing outcomes with right censoring. At each time after engagement the loan can be modified into either a temporary or a permanent modification. Lenders are unlikely to turn a temporary modification into a permanent one absent a new SFS, making transition into either category an absorbing state. We estimate conditional competing risks models of the form:

$$\lambda(t) = \lambda_{l0}(t)e^{\mathbf{X}\beta} \tag{2}$$

where $\lambda_{l0}(t)$ is a lender-specific hazard function. A mortgage can have three outcomes at each t after SFS completion: temporary modification, permanent modification, no new issued modification. Our interest variable is the $RIMR$, which will measure borrower repayment capacity in all specifications. X is the matrix of predictors recorded at time of SFS (time invariant). We control for the size of the mortgage payment, as lenders could devote more resources to high balance mortgages. We also account for the size of other debt payments, that could further impact the health of borrowers' balances sheets. We account for the impact of the loan to value ratio (in logs and with a dummy for the loan being in negative equity). We capture local dynamics thanks to region fixed effects.

Exponents of the coefficients representing the increased hazard of entering either temporary or permanent modification are reported in Table 2. Where the exponential coefficients are below one, an increase in X lowers the hazard, and vice versa where they are above one.

High RIMR borrowers are less likely to receive a temporary modification (column 1). In magnitude terms, the RIMR variable is entered into the model in adjusted standardized form, where we divide by two standard deviations to increase comparability across a range of variable types (Gelman, 2008). Increasing RIMR by two standard deviations decreases the prob-

[15] It is unlikely borrowers transition from a temporary to a permanent modification without the lender asking for an updated SFS.

ability to get a temporary modification by 47%. The housing equity effect is also sizeable: a two-SD increase in LTV ratios lowers the probability by 37%. These patterns are consistent with lenders avoiding to issue such temporary modifications to borrowers who could pay, or who are underwater. The picture is different for permanent modifications (column 2). While a 2-SD increase in LTVs lowers modification probabilities by 48%, lenders are more likely to issue permanent modifications to high RIMR borrowers. A 2-SD increase in RIMR raises the permanent modification probability by 68%.

We add conditioning factors to the model in Table 3. The coefficient on RIMR is remarkably stable. Greater ability to repay leads to 47.5% lower temporary modification probabilities (column 1) and 57.1% greater permanent modification probabilities (column 2), even controlling for the borrower's age, the type of rate, the loan vintage and its delinquency status.[16] Higher-LTV borrowers still have a lower probability to receive either type of modification. Being underwater does not seem to impact modification probabilities further, as evidenced by an insignificant coefficient on the negative equity dummy variable.

There are a number of patterns of interest among the other conditioning factors. Variable-rate loans (standard variable rate loans or tracker loans) are more likely to receive temporary modification than fixed-rate loans (column 1). The rate type does not significantly impact permanent modifications however (column 2). Couples are always more likely to have a modification outcome - temporary as well as permanent. Beyond 90 days past due, loans in deeper levels of arrears, conditional on all the above, are more likely to receive permanent modification, up to 2 years (720 days) of arrears. After this entry point to long-term arrears, the effect no longer holds statistically significant (column 2).

Given the significance of our findings on ability to repay, we investigate the linearity (or otherwise) of its effect on both extensive margins. Figure 8 reports hazard ratios for a series of dummy variables cutting the distribution of RIMR into units of 0.05, while also conditioning on all factors included in Table 3. On the left side of Figure 8, the negative effect of RIMR appears to be linear, with little evidence of kinks in the downward trend across the hazard ratio coefficients for temporary modifications.

On the right hand side, there appears to be more evidence of non-linearities in the issuance of permanent modifications. Below zero, i.e. where borrowers do not have enough residual income to make any mortgage repayment whatsoever, there appears to be minimal variation in the hazard ratio. Simply put, regardless of how negative the residual income is,

[16] As in the previous table, these RIMR coefficients are scaled so that the effects arise from a 2-SD increase in RIMR.

the lower likelihood of modification issuance appears constant, with no benefit being given to borrowers with "less negative" residuals. Above zero however, we see that the positive effect of RIMR is dominated by the sharp increase between 0 and 0.5: for borrowers who have enough income remaining after expenditures and other debts to service *some amount* of mortgage repayments, there is a very strong additional probability of receiving a modification as residual income rises. This increased likelihood of modification among those who have stronger repayment capacity may be indicative of a "triaging" approach within lenders, where those cases that appear more tractable are more likely to be handled.

The effect appears to level off, and even fall, beyond an RIMR of 0.6, implying that borrowers with the strongest levels of pre-modification ability to repay are no more likely than those with intermediate levels to receive a modification. We interpret this latter effect as a suggestion that those with the greatest levels of financial health may not receive permanent modifications because changes to expenditure, non-mortgage debt obligations, or a temporary arrangement, are likely to suffice to return the borrower to a sustainable financial footing.

4 Are Modifications Sizeable?

Having discerned the type of borrower more likely to receive a modification, we now focus on the intensive margin and analyze the change in monthly repayment post-modification. The majority of modifications result in payment reductions (Fig. 9). Temporary arrangements lead to larger cuts in repayments. Those arrangements provide short-term liquidity relief, but might only delay default in cases where borrowers' income shocks are permanent.

Do bigger cuts in repayment lead to lower debt burdens ex-post? We investigate the strength of the relationship in Figure 10. The relationship is clearly strong and positive, with more negative levels of payment change (δM, the difference between the modified monthly installment and the amortizing payment normalized by amortizing payment) closely related to lower ex-post payment-to-income (PTI) ratios. The relationship is not linear, with cases of large negative δM not always leading to very low PTI levels, due to cases where borrowers start at extremely high ex-ante PTIs.

We analyze the impact of the borrowers' ability to repay on the size of repayment cuts in the following regression:

$$\delta M_{i,t} = \beta \text{RIMR}_{i,t} + \gamma X_{i,t} + \nu_c + \mu_b + \lambda_t + \epsilon_{i,t} \tag{3}$$

We observe one δM per modification. RIMR is the standardized residual income to mortgage ratio, where the mean is divided by two standard deviations as in the previous section. X is a set of borrower and loan characteristics. As lenders estimate affordable mortgage payments, they are likely to pay attention to the household's structure and balance sheet. We thus account for the size of non-mortgage debt payment (in log), the number of borrowers, the size of the household, the age of the borrower, and where they live (region fixed effects ν_c). We control for the time of modification (λ_t) and the lender (μ_b). As lenders might balance modification against foreclosures, we control for the current loan-to-value of the loan (standardized) and whether the loan is in negative equity. Reflecting other measures associated with risk profile, we control for the number of days past due, the loan's vintage, and the type of interest rate.

Results are displayed in Table 4, firstly for all modifications, secondly for temporary arrangements only, and finally for permanent modifications. We firstly note the findings on our key explanatory variable, RIMR. A two-standard-deviation increase in RIMR is associated an increase in δM of 0.348, where the sample mean of δM is 0.3. This implies that banks respond to lower levels of residual income (a lower value of RIMR) with substantially greater cuts in repayment (a larger negative value for δM). Columns (3) and (4) then show that the effect of weaker repayment capacity on repayment cuts is twice as large for permanent as for temporary modifications. Put simply, banks offer deeper modifications to those with weaker repayment capacity. Under the modification imperative imposed by the regulators, banks manage to extract payments proportional to repayment abilities. It suggests they can meet modification targets while maximising future income.

Looking at indebtedness *levels*, the models suggest that borrowers with higher levels of non-mortgage debt receive less generous cuts to repayment (higher values of δM). Similarly, borrowers with higher mortgage LTV ratios have higher δM values, implying less generous modifications, albeit with a negative intercept adjustment for those in negative equity. These results suggest that, when banks are looking to adjust mortgage burdens to account for borrowers' financial health, their focus is on borrowers' ongoing repayment capacity (a *liquidity* view of the borrower) rather than on debt levels or LTVs (a *leverage* view).

Our demographic coefficients suggest that banks issue deeper repayment cuts to couples over single borrowers, and to older borrowers. Borrowers on variable rate loans receive larger repayment cuts than those with fixed rate mortgages. Loans issued before 2004 appear to receive the deepest modifications, while there is little statistical difference in δM for loans originated between 2004 and 2009. Looking at arrears levels, those with arrears less than

90 days receive deeper modifications than those with arrears between 90 and 720 days, evidenced by the positive coefficients on categories (90-180, 180-360,360-720). By contrast, δM is most negative for those loans in very deep arrears of over 2 years that receive a modification, consistent with our finding that those with the weakest repayment capacity receive more generous repayment cuts. This is in contrast to the extensive margin, where we have shown that loans in the longest-term arrears are less likely to be modified (section 3).

Table 5 investigates whether any of the above patterns shift meaningfully either side of the introduction of MART, after which lenders were obliged to issue modifications of a more sustainable nature widely and rapidly. The coefficient on RIMR is positive and significant for both temporary and permanent arrangements either side of the MART introduction, suggesting a robust pattern whereby deeper modifications were issued to those whose repayment capacity required them most. The sensitivity of δM to RIMR is greater for permanent than for temporary arrangements, as in Table 4. When looking across time, the effect for both modification types is greater during the MART phase, suggesting some shift in banks' allocation strategies in response to the policy inducement to modify at scale. Further, loan size becomes irrelevant to repayment cuts for both permanent and temporary modifications in the post-MART environment. And being underwater becomes relevant to permanent modifications as its importance fades for temporary ones. This could be the result of the bulk of modifications shifting from temporary to permanent under this new regime.

When all is said and done, who ends up with more sustainable repayment burdens after the modification has been issued? To answer this question we repeat the previous specifications with the post-modification PTI ratio as the dependent variable (Table 6). Looking first at RIMR, following our finding that banks issue more generous modifications to those with less residual income, we now show that despite this, those with greater repayment capacity (higher RIMR) have lower PTI ratios after the event. This suggests that the "equalising" effect of banks issuing greater repayment cuts to those needing it most does not offset the fact that those with weaker repayment capacity entered the modification process with much greater repayment difficulties. The coefficient on RIMR is again negative and significant for both temporary and permanent arrangements either side of the MART introduction (Table 7).

There may be important non-linearities in the way lenders allocate modifications, particularly as a function of borrowers' ability to repay. In Figure 11 we introduce a set of dummy variables representing each interval of width 0.05 in the RIMR distribution into specification 2 and 3 (separate models for each modification type) of Table 4. Panel (A) and (B) report a similar pattern when modelling δM: when borrowers have no residual income, increasing

levels of repayment capacity have no effect on the intensive margin. Similarly, when borrowers have residual income that is greater than their contracted mortgage payment, there is no relationship. The elasticity is highest in an intermediate range of RIMR. At a RIMR of 1, δM is 0.3 higher than at a RIMR of zero, implying those greater repayment capacity are smaller reductions, in absolute value, in their repayments.

5 Modified Loans Performance

We now turn to analyzing how effective modifications are at reducing subsequent losses. We define a modification as having failed if the loan transitions to a worse delinquency status or a new modification. For example, if a loan is modified to 0 days past due, we will set the failure dummy to a 1 if it is 30 days past due next period.

Six months after modification, 80% of permanently modified loans keep making payments (Figure 12). But only 50% of *temporarily* modified loans do. Two years after modification, survival rates are down to 65% for permanent modifications and 25% for temporary ones. Permanent modifications do solve payment issues for most loans but the failure rate conditional on modification remains quite high. For context, even at its maximum level, 13 per cent of mortgages had arrears worth more than three missed payments, with typical transition rates per year into mortgage default being under ten per cent.

Post- modification payment-to-income ratios drive failure rates (Figure 13). 16% of borrowers with a 20% PTI fail in a given quarter. The share increases to 23% of borrowers with a PTI of 50%. When payments make up more than 40% of income, failure rates grow even faster with PTI ratios: more than a quarter of borrowers with a 70% PTI fail.

We confirm the importance of payment to income levels in a linear probability model set-up:

$$\text{Failure}_{i,t} = h_t + \beta PTI_{i,t} + \gamma X_{i,t} + \nu_c + \mu_b + \lambda_t + \epsilon_{i,t} \tag{4}$$

$Failure_{(i,t)}$ is a dummy set to 1 at date t if borrower i's loan enters delinquency or is modified again at date t. We start observing loans 6 months after modification. PTI is the current payment-to-income ratio for borrower i. Because stress is more likely as time passes, we control for h_t, the number of months since modification. We include quarter fixed effects λ_t to account for the macroeconomic environment. We capture local time-invariant regional economic factors using a vector of region fixed effects ν_c. Lender fixed effects μ_b account for lender specific portfolio characteristics and modification strategy. Loan specific controls

X can include a temporary modification dummy, the standardised current LTV, the quarter over quarter change in payment-to-income ratio, the modification vintage, the log of the borrower's expenditure, and the number of borrowers and their dependent children.

Higher levels of PTI drive failure rates up (Table 8). Setting payment-to-income ratios 10 percentage point higher raises the failure rate by 0.8 percentage point (column 2). This is relative to an average quarterly failure rate in the sample of 11 per cent. The effect is stronger when payment makes up more than 40% of income (column 3). Increasing payment-to-income ratios by 10 percentage point increases the failure rate by 1 percentage point when PTIs are greater than 40%.

Moving from one standard deviation below to one standard deviation above mean LTV (77 percentage point move) would increase quarterly failure rates by 3.5 percentage points in the unsaturated specification of column 4. This is equivalent to increasing the PTI ratio by about 48 percentage points.

Further, there is a strong interaction effect between LTV and PTI levels (column 5). For this test, we re-scale the PTI variable so the current LTV coefficient can be interpreted as the effect when PTI is equal to 20%. The impact of current LTV sharply increases as payment to income ratios do.

Post modification changes in PTI also have a sizeable impact on failure rates.[17] Borrowers whose PTI increases by 10 percentage point are 17 percentage points more likely to fail. Results remain unchanged when controlling further for vintage, expenditures, size of households, and number of kids (column 7). Of note is the increase in the size of the LTV coefficients in columns 6 and 7, by between five and six times between the model of column 4 and a fully saturated model with controls and PTI changes included in column 7.

These estimations also confirm temporary modifications have higher failure rates than permanent ones. Part of this effect can be explained by permanent modifications issued *after* the borrower was put on a temporary payment moratorium. We estimate the models for permanent modifications only in Table 9. PTI is still a key driver of failure rates in this sample. Setting payment-to-income ratios 10 percentage points higher raises the failure rate by 0.6 percentage point (column 2). But the effect is not sharper for PTIs larger than 40% (column 3). Consistently with the combined sample results, current LTV plays a more minor role than PTI to explain post modification failures (column 4). And the LTV effect does not rise with

[17] Those PTI changes are all post modifications and can be driven by changes in interest rates.

PTI for permanent modifications (column 5). The impact of changes in PTI is again sizeable in this sub-sample (columns 6 and 7).

6 Conclusion

We build on the lessons from the US modification experience by using the recent Irish mortgage arrears crisis as a laboratory to study lender and borrower behaviour under a set of special circumstances: foreclosure threat is weak; banks are incentivised to modify under threat of provisioning penalty but have full discretion on the type and depth of modification offered; lenders operate under full information on borrowers' finances.

Our results suggest that banks, to a large extent, utilize their strong information set to deliver modifications, directionally at least, to target modifications towards those with greatest need. In particular, our intensive margin regressions show that, when issuing modifications, those with weaker repayment capacity receive greater cuts to repayments. We show that banks are more responsive to such liquidity effects than they are to equity or leverage positions of borrowers when cutting repayments.

On the extensive margin, a more mixed picture emerges. Banks issue temporary modifications more readily to borrowers with weaker repayment capacity, in line with the findings above. However, for permanent modifications, we find a non-linear relationship, where those with very strong or very weak repayment capacity are less likely to receive a modification than those with an intermediate level. On average, we show that higher loan to value ratios predict lower modification probabilities.

Finally, we confirm previous findings in the mortgage default and modification literature that borrower liquidity and leverage are both important determinants of ex-post modification success. Re-default rates are lower for borrowers with lower Payment to Income and Loan to Value ratios. Further, in line with double-trigger approaches to mortgage default, we show through interaction effects that these factors reinforce each other.

Our findings suggest that, in the main, a modification system that is non-interventionist in the way banks modify loans can lead to many desirable outcomes. The Irish institutional environment during our study meant that banks were armed with close to perfect information on borrower financial health when making modification decisions. Our research shows that banks use this information to deliver deeper modifications to those who need payment relief

most, but that extensive margin deviations from this trend imply that a cohort of borrowers in deepest financial difficult may miss out due to banks' allocation practices. Overarching policy responses to financial crises may need to allow for these trends, with complementary social policies required to ensure access to housing among borrowers not receiving private modifications.

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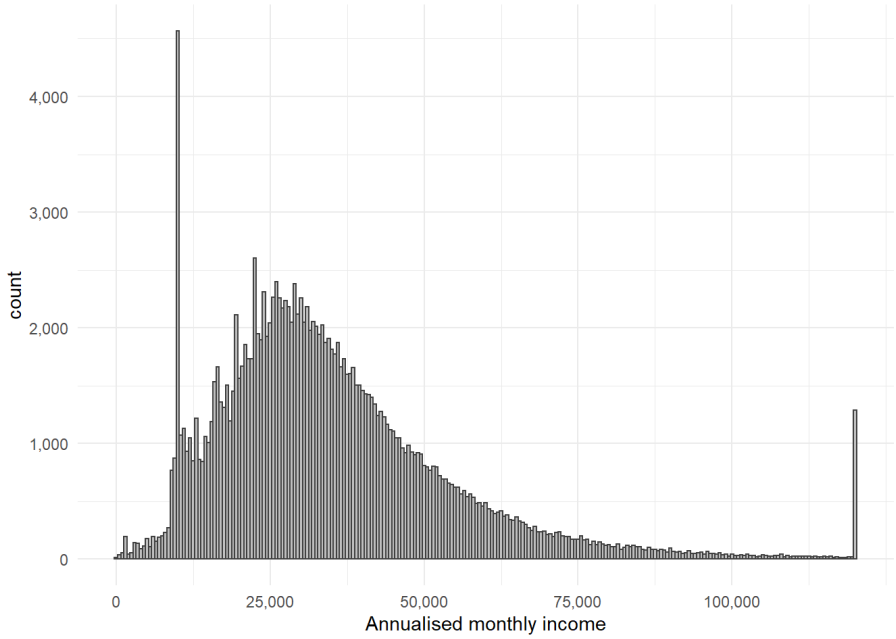
Figure 1: Annualised Household Income Distribution, SFS Entries



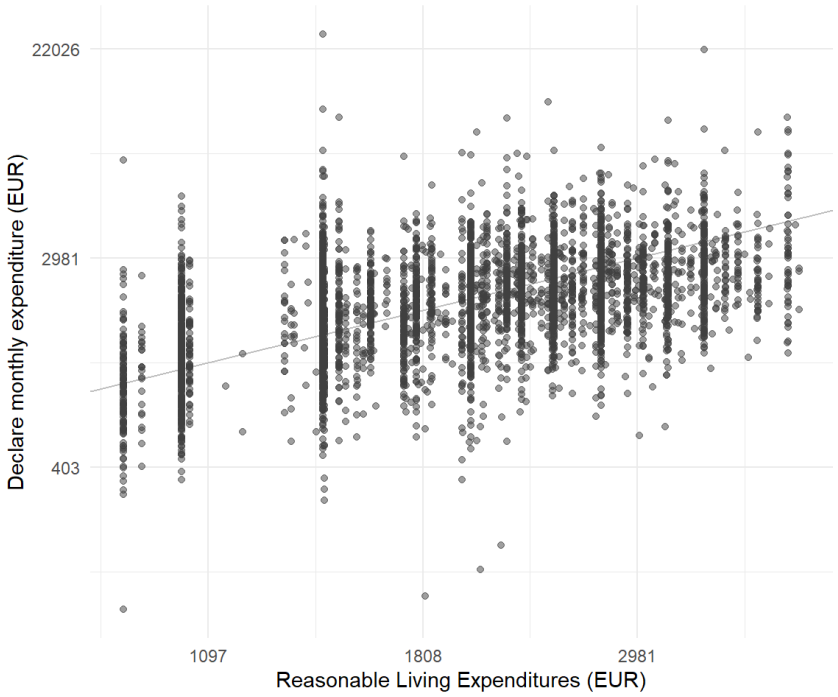
Note: Distribution of income among SFS entries. Annualized figures computed as reported net monthly income multiplied by twelve.

Table 1: Summary Statistics (LLD-SFS Sample)

	mean	p0.25	p0.5	p0.75
Demographic variables				
Number of People Filing SFS	1.68	1	2	2
Age of Primary Borrower	44.68	38	44	51
Household Size	3.23	2	3	4
Household Financial Health				
Monthly Income	2,869	1,853	2,622	3,633
Monthly Expenditure	2,052	1,365	1,916	2,581
Reasonable Living Expenses	2,065	1,432	2,022	2,707
Monthly Mortgage Payment (Amortizing)	1,186	805	1,078	1,427
Other Debt Payments	345	0	156	487
Surplus	-751	-1173	-641	-227
Residual Income	448	-3.81	414	871
Residual Income to Income	0.14	0.01	0.17	0.3
Residual Income to Mortgage	0.36	0	0.39	0.74
Payment to Income	0.5	0.3	0.41	0.59
Loan Characteristics				
Current Loan to Value	1.01	0.64	1.01	1.37
Loan to Value at Origination	0.68	0.5	0.73	0.9
Interest Rate (%)	3.41	1.95	4.25	4.5
Tracker Rates (share)	0.4	0	0	1
Fixed Rates (share)	0.07	0	0	0
Outstanding Balance	192,252	117,161	182,495	254,131
Months to Maturity	230.73	156	240	317
Performance				
Arrears	7,320	0	1,786	10,060
Days Past Due	237	0	67	320
Modified Loans	0.45	0	0	1
Temporary Modification	0.35	0	0	1
Permanent Modification	0.11	0	0	0

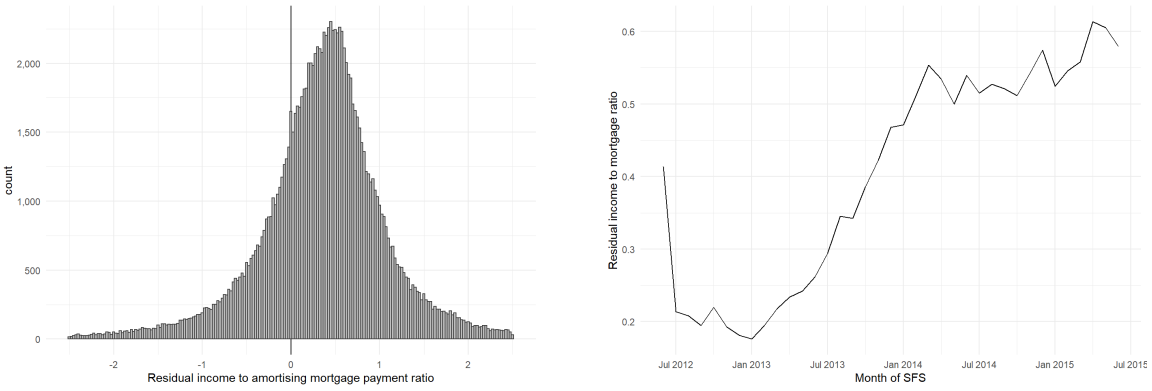
Note: Summary statistics for the joint Standard Financial Statement - Loan Level Data dataset. Mortgage variables are joined from loan-level data at time point immediately preceding the date of SFS completion. Mean of 1-percent trimmed variable. Reasonable Living Expenses defined by the Insolvency Services of Ireland and computed at the borrower (household) level using SFS data on car ownership and number of children. Monthly mortgage payment computed from Loan Level Data dataset using an amortisation formula across all outstanding loans in a time period for a household (facility). Surplus computed as income minus non-housing expenditures, and mortgage and other debt payments.

Figure 2: Reported Expenditures against Implied Reasonable Living Expenditures.



Note: Reasonable Living Expenditure defined by the Insolvency Services of Ireland and computed at the borrower (household) level using SFS data on car ownership and number of children. Declared Expenditures observed in SFS filings. All households with the same composition are classified with the same RLE amount.

Figure 3: Residual Income to Mortgage Ratio

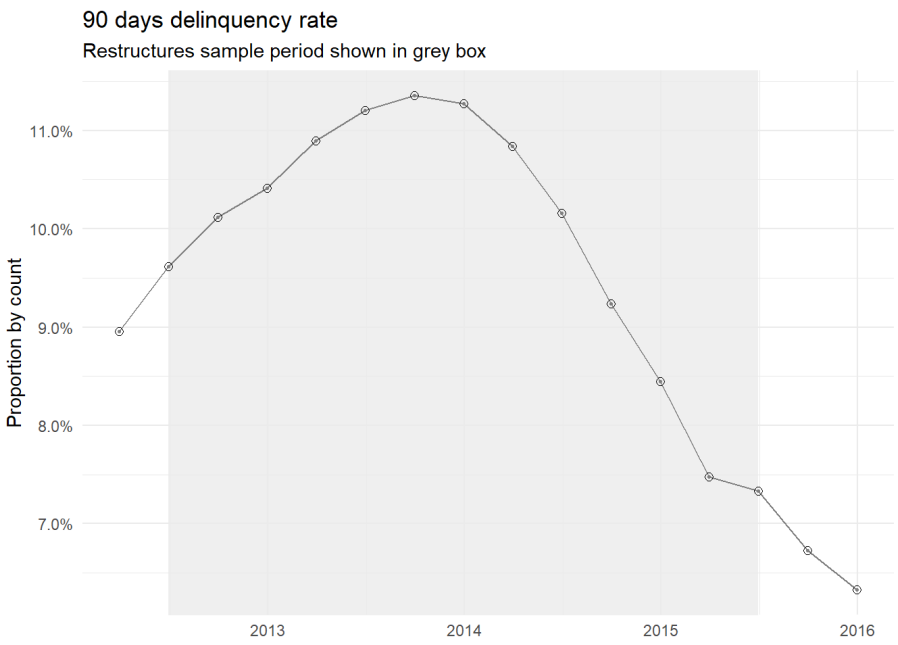


(a) Distribution

(b) Over time

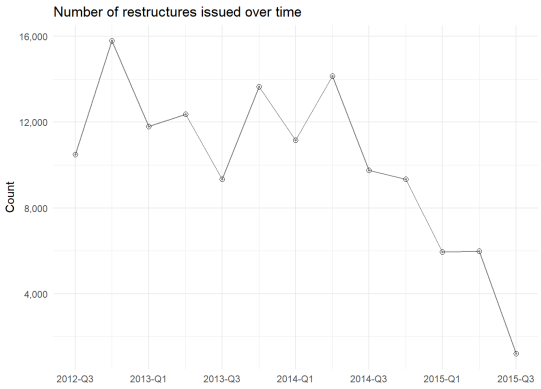
Note: Residual income is computed as reported net monthly household income minus reported monthly expenditure on non-housing items and non-mortgage debt payments. We consider the ratio of this quantity to the mortgage payment.

Figure 4: 90-day Arrears Rate (Default Rate) in the Estimation Sample

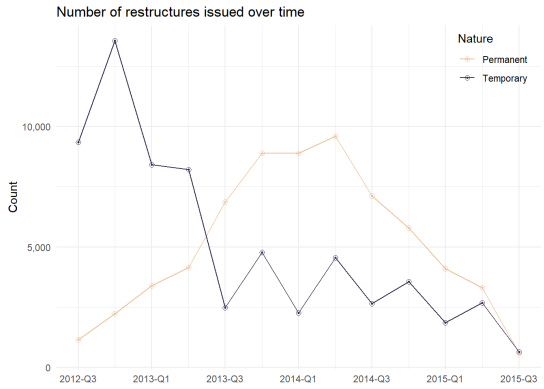


Note: Default rate across mortgages in the merged loan-level - standard financial statement dataset (estimation sample).

Figure 5: Timeline of Modifications Issuance



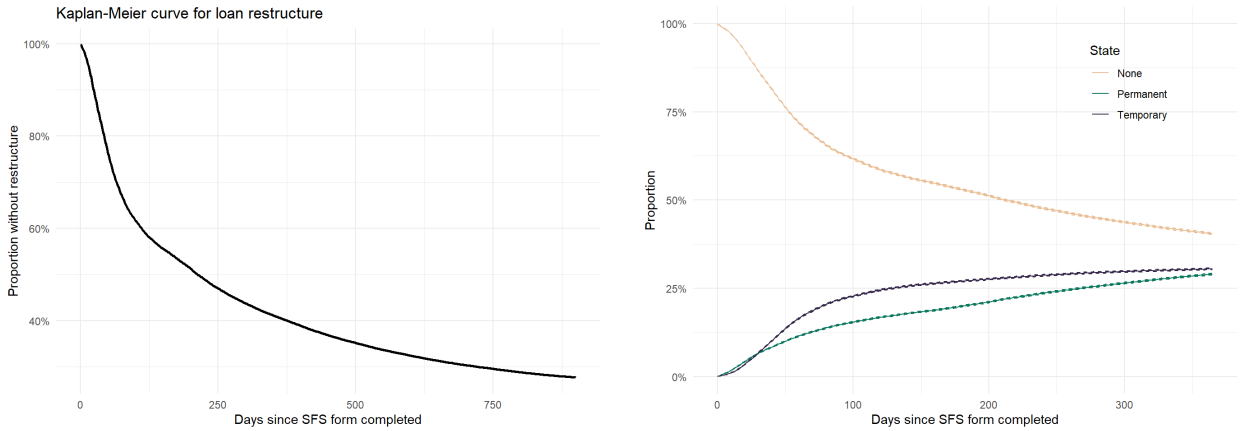
(a) Number of Modifications Issued



(b) Type of Modifications Issued

Note: Number of modifications observed in the merged loan-level - standard financial statement dataset (estimation sample), for all modifications and by type.

Figure 6: Time to Modification After Engagement.

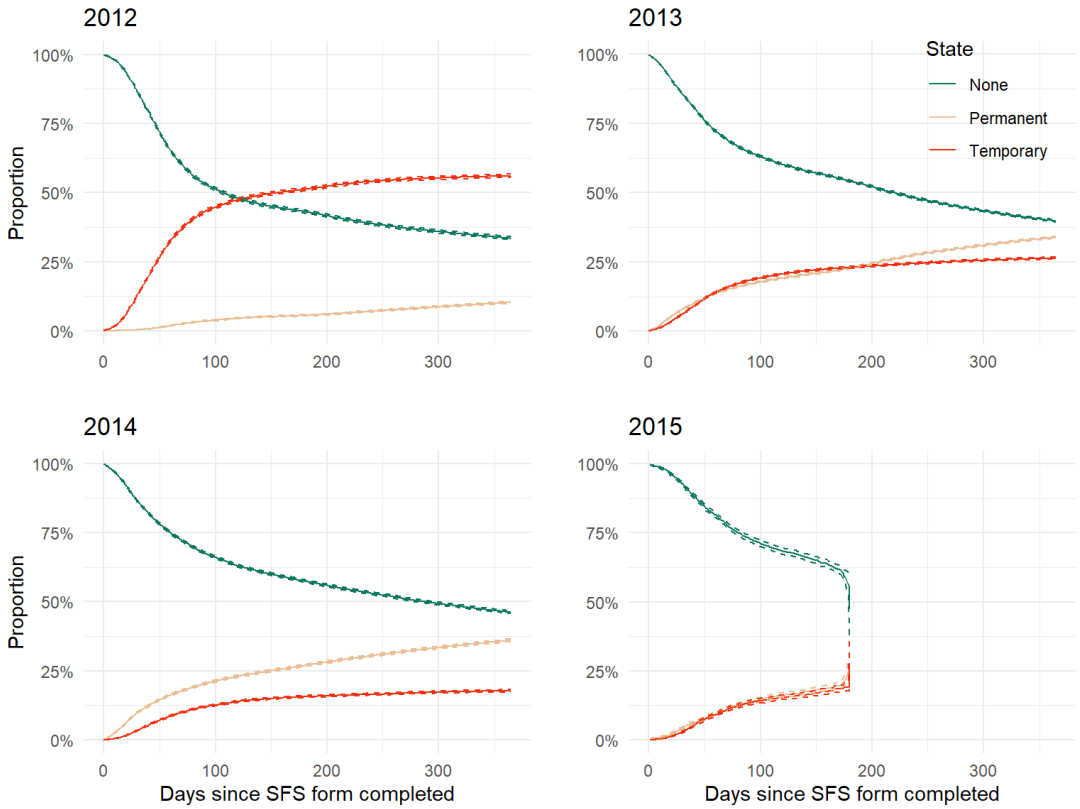


(a) Kaplan-Meier curve, all modifications

(b) Cumulative incidence by modification type

Note: Kaplan-Meier and Cumulative Incidence curves for the time to modification post engagement. The baseline hazard function is estimated for all SFS entries.

Figure 7: Time to Modification After Engagement, by Modification Type and Vintage



Note: Time to modification post engagement, by modification type and modification vintage.

Figure 8: Non-linear effects of Residual Income to Mortgage Repayment

Note: Hazard ratios for a series of dummy variables cutting the distribution of the Residual Income to Mortgage Ratio (RIMR) into units of 0.05 (reference category $(0, 0.05]$). A mortgage can have three outcomes at each date after SFS completion: temporary modification, permanent modification, no new issued modification. We condition on the size of mortgage and non-mortgage debt payments, current LTV, negative equity, the borrower's age, the type of rate, the loan vintage, its delinquency status, and lender and region fixed effects.

Table 2: Baseline Extensive Margin Model

	Temporary		Permanent	
	Est	CI	Esti	CI
Log(Mortgage Balance)	0.938	(0.917,0.959)	1.007	(0.985,1.029)
Log(Other Debt Balances)	0.981	(0.976,0.985)	1.019	(1.015,1.023)
Current Mortgage LTV	0.633	(0.525,0.764)	0.518	(0.433,0.620)
Negative Equity Dummy	1.001	(0.962,1.041)	1.106	(1.065,1.149)
$RIMR$	0.533	(0.507,0.560)	1.683	(1.603,1.767)

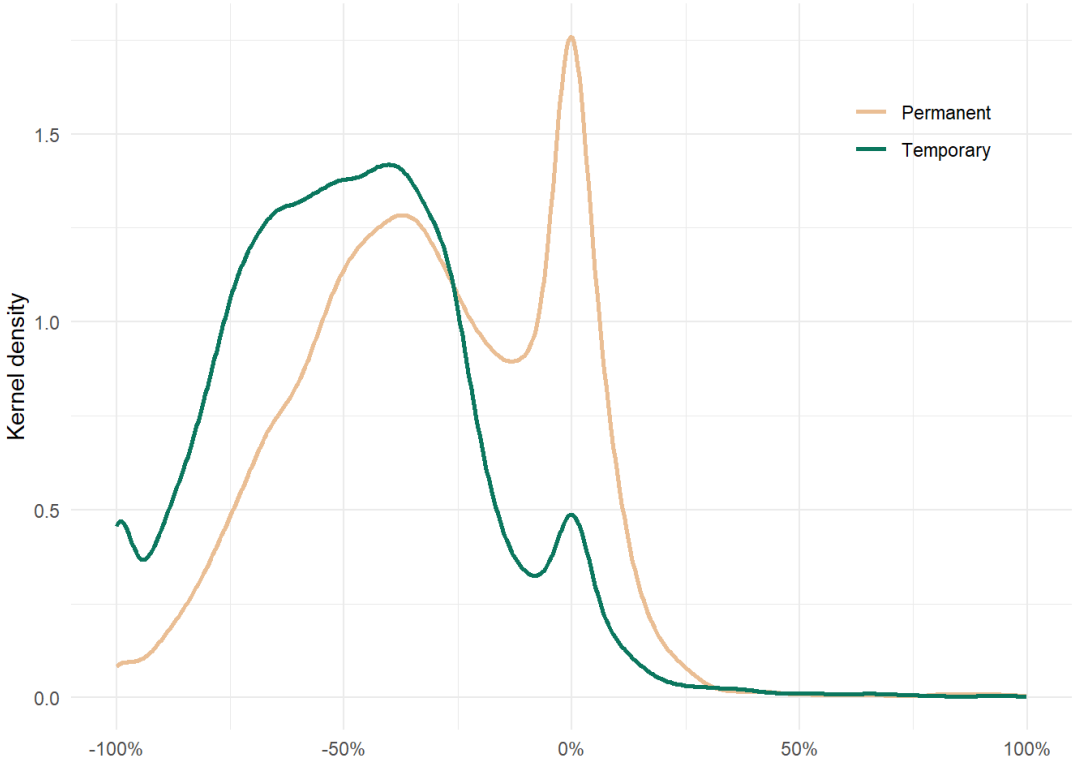
Note: Models estimated by Cox Proportional Hazard, with coefficients on quarter-of-origination, region and lender fixed effects all omitted for brevity. Hazard ratios reported, with values above 1 indicating baseline hazard is increasing in X of interest. $RIMR$ is the ratio of residual income (income less non-mortgage outgoings) to monthly ex-ante mortgage repayments. Both $RIMR$ and Current LTV are standardised in an adjusted form such that coefficients are interpreted as *two standard deviation* moves in each variable.

Table 3: Extensive Margin, Saturated Model

	Temporary		Permanent	
	Estimate	Confidence Interval	Estimate	Confidence Interval
Age (Primary Borrower)	1.004	(1.002,1.005)	0.991	(0.990,0.993)
DPD (180,365]	0.726	(0.701,0.753)	1.341	(1.302,1.381)
DPD (365,720]	0.584	(0.560,0.608)	1.217	(1.179,1.256)
DPD (720,Inf]	0.499	(0.475,0.523)	1.005	(0.971,1.041)
DPD (90,180]	0.870	(0.838,0.903)	1.351	(1.307,1.397)
Interest Rate Type: SVR	1.082	(1.041,1.126)	1.000	(0.960,1.043)
Interest Rate Type: Tracker	1.093	(1.049,1.139)	1.037	(0.993,1.082)
Log(Mortgage Balance)	1.036	(1.012,1.061)	0.895	(0.875,0.916)
Log(Other Debt Balances)	0.969	(0.965,0.973)	1.017	(1.013,1.021)
Current Mortgage LTV	0.687	(0.543,0.870)	0.677	(0.539,0.851)
Negative Equity Dummy	1.000	(0.961,1.041)	1.092	(1.051,1.135)
Number of Borrowers	1.046	(1.018,1.074)	1.059	(1.032,1.086)
$RIMR$	0.525	(0.499,0.552)	1.571	(1.496,1.649)
Vintage: 2006	0.971	(0.934,1.010)	0.914	(0.881,0.948)
Vintage: [2004,2006)	1.005	(0.970,1.040)	0.922	(0.893,0.953)
Vintage: [2007,2009)	1.009	(0.974,1.046)	0.889	(0.859,0.920)
Vintage: [2009,2014]	1.133	(1.081,1.187)	0.762	(0.724,0.803)

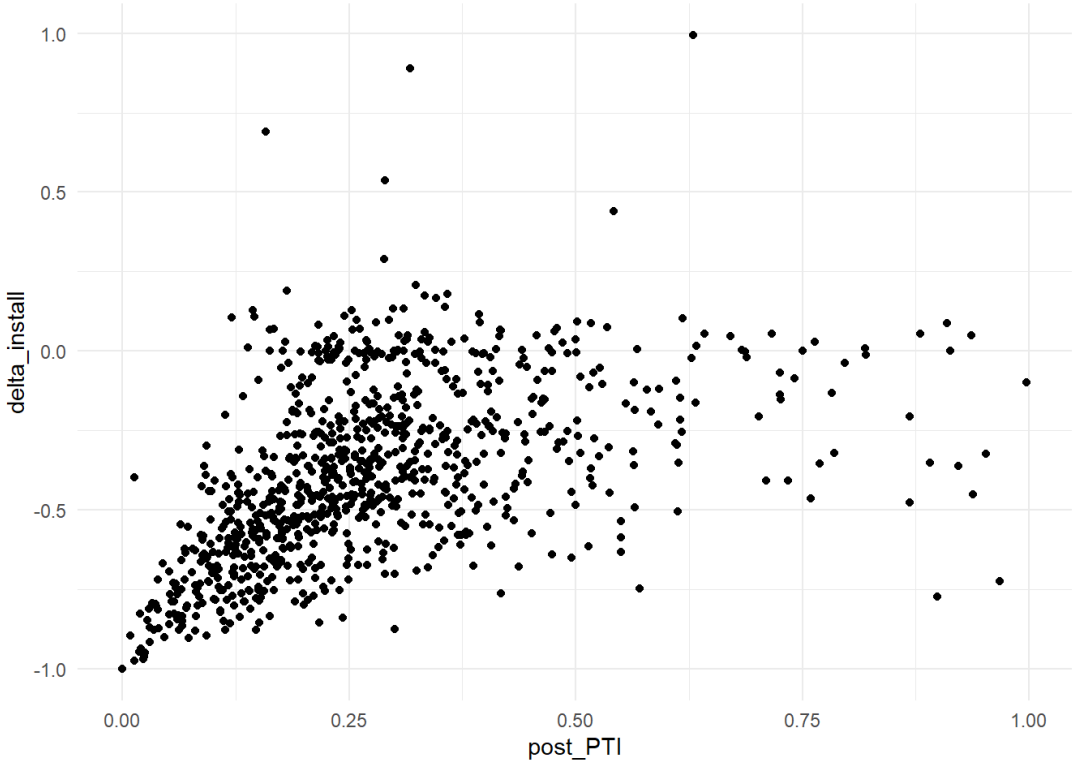
Note: Models estimated by Cox Proportional Hazard, with coefficients on quarter-of-origination, region and lender fixed effects all omitted for brevity. Hazard ratios reported, with values above 1 indicating baseline hazard is increasing in X of interest. $RIMR$ is the ratio of residual income (income less non-mortgage outgoings) to monthly ex-ante mortgage repayments. Both $RIMR$ and Current LTV are standardised in an adjusted form such that coefficients are interpreted as *two standard deviation* moves in each variable. Interest Rate Types relative to Fixed-Rate. Vintage: relative to base category of loans issued before 2004. Days Past Due (DPD) coefficients relative to loans with less than 90 days arrears. Categories refer to number of days of arrears at the point of SFS completion.

Figure 9: Modification Size by Modification Type



Note: Density plots of modification size by modification type. We measure modification size as the difference between the modified monthly installment and the amortizing payment (normalized by amortizing payment, δM).

Figure 10: Modification Size and Post-Modification Payment-to-Income Ratios



Note: Plot of modification size against post-modification payment-to-income ratios for a random draw of size 1,000. We measure modification size as the difference between the modified monthly installment and the amortizing payment (normalized by amortizing payment).

Table 4: Modification Size ($Y = \delta M$), All Modification Types

	Both	Temporary	Permanent
$RIMR$	0.348***	0.201***	0.424***
	(0.005)	(0.007)	(0.008)
Other Debt Balances	0.016***	0.009***	0.017***
	(0.000)	(0.001)	(0.001)
Current Mortgage LTV	0.094***	0.203***	0.008
	(0.025)	(0.033)	(0.035)
Negative Equity Dummy	-0.021***	-0.013**	-0.039***
	(0.004)	(0.005)	(0.006)
Number of Borrowers	-0.030***	-0.026***	-0.032***
	(0.003)	(0.004)	(0.004)
Household Size	0.005***	0.005***	0.001
	(0.001)	(0.001)	(0.001)
Age (Primary Borrower)	-0.004***	-0.005***	-0.003***
	(0.000)	(0.000)	(0.000)
Interest Rate Type: SVR	-0.021***	-0.017***	-0.015**
	(0.004)	(0.005)	(0.006)
Interest Rate Type: Tracker	-0.098***	-0.153***	-0.037***
	(0.005)	(0.006)	(0.007)
Vintage: [2004,2006)	0.019***	0.022***	0.020***
	(0.004)	(0.005)	(0.005)
Vintage: 2006	0.014***	0.021***	0.010*
	(0.004)	(0.005)	(0.006)
Vintage: [2007,2009)	0.020***	0.034***	0.011**
	(0.004)	(0.005)	(0.005)
Vintage: [2009,2014]	0.063***	0.074***	0.060***
	(0.005)	(0.007)	(0.008)
DPD: (90,180]	0.051***	0.028***	0.050***
	(0.004)	(0.005)	(0.005)
DPD: (180,365]	0.044***	0.017***	0.039***
	(0.003)	(0.005)	(0.004)
DPD: (365,720]	0.022***	0.000	0.012**
	(0.004)	(0.006)	(0.005)
DPD: (720+]	-0.044***	-0.061***	-0.054***
	(0.004)	(0.007)	(0.005)
Log(Mortgage Balance)	0.001	0.009**	0.013***
	(0.003)	(0.003)	(0.004)
Num Obs	50611	26155	24456
R2	0.254	0.229	0.258

* p < 0.1, ** p < 0.05, *** p < 0.01

Note: Models estimated by OLS, with coefficients on quarter-of-origination, region and lender fixed effects all omitted for brevity. δM is the percentage change in monthly mortgage payments due to the modification. $RIMR$ is the ratio of residual income (income less non-mortgage outgoings) to monthly ex-ante mortgage repayments. Both $RIMR$ and Current LTV are standardised. Interest Rate Types relative to Fixed-Rate. Vintage relative to base category of loans issued before 2004. Days Past Due (DPD) coefficients relative to loans with less than 90 days arrears. Categories refer to number of days of arrears at the point of SFS completion.

Table 5: Modification Size ($Y = \delta M$), Either Side of MART Policy Implementation, by Modification Type.

	Pre, Temp.	Post, Temp.	Pre, Perm.	Post, Perm.
$RIMR$	0.131***	0.266***	0.303***	0.461***
	(0.009)	(0.012)	(0.018)	(0.009)
Other Debt Balances	0.004***	0.013***	0.011***	0.018***
	(0.001)	(0.001)	(0.002)	(0.001)
Current Mortgage LTV	0.213***	0.217***	0.074	-0.005
	(0.037)	(0.060)	(0.089)	(0.037)
Negative Equity Dummy	-0.017***	-0.006	-0.016	-0.043***
	(0.006)	(0.010)	(0.015)	(0.006)
Number of Borrowers	-0.019***	-0.033***	-0.032***	-0.032***
	(0.004)	(0.007)	(0.010)	(0.004)
Household Size	0.004***	0.007***	0.002	0.002
	(0.001)	(0.002)	(0.003)	(0.001)
Age (Primary Borrower)	-0.004***	-0.005***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.001)	(0.000)
Interest Rate Type: SVR	-0.013**	-0.020*	0.009	-0.016**
	(0.006)	(0.011)	(0.014)	(0.007)
Interest Rate Type: Tracker	-0.159***	-0.140***	-0.051***	-0.031***
	(0.006)	(0.011)	(0.014)	(0.008)
Vintage: [2004,2006)	0.019***	0.028***	0.022*	0.020*** *
	(0.005)	(0.009)	(0.012)	(0.005)
Vintage: 2006	0.012*	0.032***	0.021	0.009
	(0.006)	(0.010)	(0.014)	(0.006)
Vintage: [2007,2009)	0.027***	0.042***	0.011	0.012**
	(0.006)	(0.009)	(0.013)	(0.006)
Vintage: [2009,2014]	0.067***	0.086***	0.077***	0.057***
	(0.008)	(0.011)	(0.019)	(0.008)
DPD: (90,180]	0.007	0.058***	0.049***	0.050***
	(0.006)	(0.009)	(0.013)	(0.005)
DPD: (180,365]	-0.002	0.046***	0.030***	0.040***
	(0.006)	(0.009)	(0.011)	(0.005)
DPD: (365,720]	-0.024***	0.026***	0.010	0.012**
	(0.007)	(0.010)	(0.013)	(0.005)
DPD: (720,Inf]	-0.067***	-0.052***	-0.079***	-0.050***
	(0.009)	(0.010)	(0.017)	(0.005)
Log(Mortgage Balance)	0.023***	-0.010	0.033***	0.006*
	(0.004)	(0.006)	(0.008)	(0.004)
Num Obs	15503	10652	4403	20053
R2	0.227	0.239	0.206	0.281

* p < 0.1, ** p < 0.05, *** p < 0.01

Note: Models estimated by OLS, with coefficients on quarter-of-origination, region and lender fixed effects all omitted for brevity. δM is the percentage change in monthly mortgage payments due to the modification. $RIMR$ is the ratio of residual income (income less non-mortgage outgoings) to monthly ex-ante mortgage repayments. Both $RIMR$ and Current LTV are standardised. Interest Rate Types relative to Fixed-Rate. Vintage: relative to base category of loans issued before 2004. Days Past Due (DPD) coefficients relative to loans with less than 90 days arrears. Categories refer to number of days of arrears at the point of SFS completion. Pre refers to the Pre-MART period, post the post-MART period.

Table 6: Post-Modification Payment-to-Income ($Y = PTI$), by Modification Type

	All	Temporary	Permanent
$RIMR$	-0.073***	-0.098***	-0.077***
	(0.003)	(0.004)	(0.004)
Other Debt Balances	-0.007***	-0.009***	-0.007***
	(0.000)	(0.000)	(0.000)
Current Mortgage LTV	-0.001	0.069***	-0.068***
	(0.013)	(0.018)	(0.017)
Negative Equity Dummy	-0.001	-0.002	-0.004
	(0.002)	(0.003)	(0.003)
Number of Borrowers	-0.035***	-0.035***	-0.035***
	(0.001)	(0.002)	(0.002)
Household Size	-0.020***	-0.020***	-0.022***
	(0.000)	(0.001)	(0.001)
Age (Primary Borrower)	0.001***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)
Interest Rate Type: SVR	-0.017***	-0.013***	-0.018***
	(0.002)	(0.003)	(0.003)
Interest Rate Type: Tracker	-0.093***	-0.110***	-0.071***
	(0.002)	(0.003)	(0.003)
Vintage: [2004,2006)	0.002	0.004	0.003
	(0.002)	(0.003)	(0.002)
Vintage: 2006	-0.002	0.002	-0.005*
	(0.002)	(0.003)	(0.003)
Vintage: [2007,2009)	0.003	0.010***	-0.003
	(0.002)	(0.003)	(0.003)
Vintage: [2009,2014]	0.004	0.011***	0.000
	(0.003)	(0.004)	(0.004)
DPD: (90,180]	0.020***	0.017***	0.014***
	(0.002)	(0.003)	(0.003)
DPD: (180,365]	0.021***	0.022***	0.012***
	(0.002)	(0.003)	(0.002)
DPD: (365,720]	0.024***	0.024***	0.016***
	(0.002)	(0.003)	(0.002)
DPD: (720+]	0.026***	0.018***	0.021***
	(0.002)	(0.004)	(0.003)
Log(Mortgage Balance)	0.087***	0.090***	0.092***
	(0.001)	(0.002)	(0.002)
Num Obs	52398	27441	24957
R2	0.276	0.293	0.291

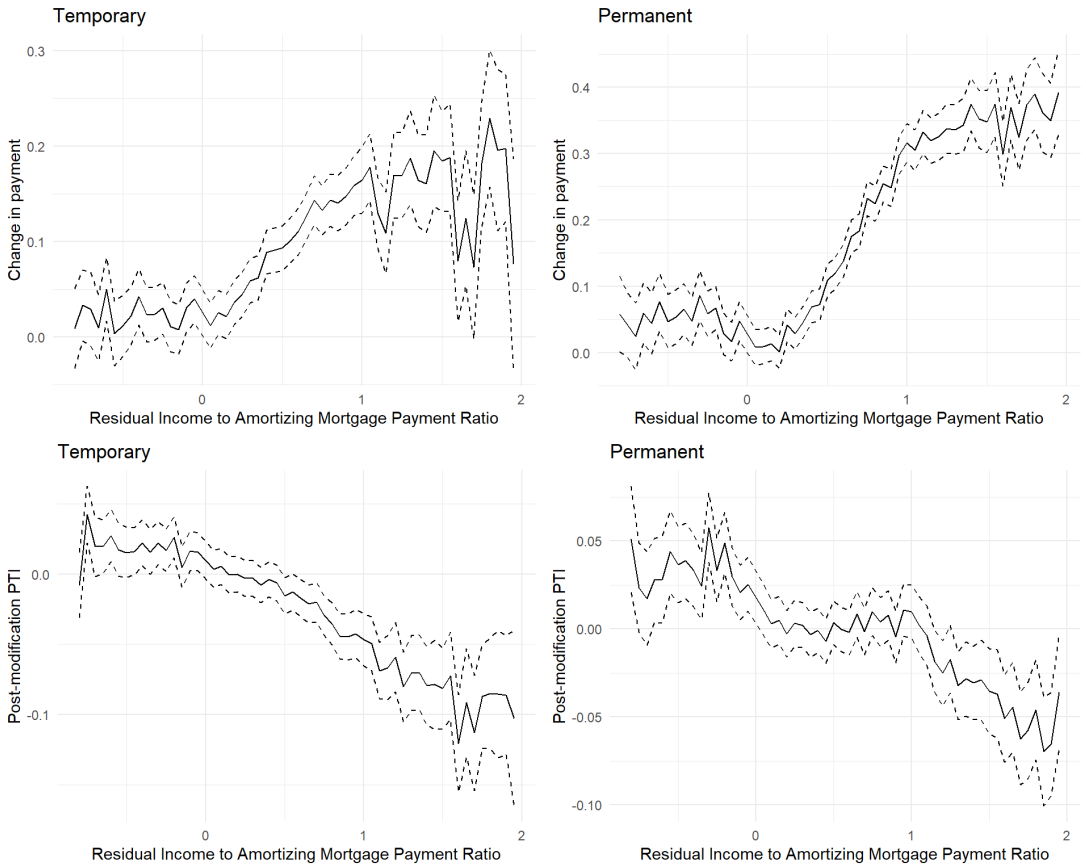
Note: Models estimated by OLS, with coefficients on quarter-of-origination, region and lender fixed effects all omitted for brevity. PTI is the ratio of post-modification mortgage repayments to net monthly household income. $RIMR$ is the ratio of residual income (income less non-mortgage outgoings) to monthly ex-ante mortgage repayments. Both $RIMR$ and Current LTV are standardised. Interest Rate Types relative to Fixed-Rate. Vintage relative to base category of loans issued before 2004. Days Past Due (DPD) coefficients relative to loans with less than 90 days arrears. Categories refer to number of days of arrears at the point of SFS completion.

Table 7: Post-Modification Payment-to-Income ($Y = PTI$), Either Side of MART Policy Implementation, by Modification Type.

	Pre, Temp.	Post, Temp.	Pre, Perm.	Post, Perm.
$RIMR$	-0.089***	-0.113***	-0.084***	-0.073***
	(0.005)	(0.007)	(0.009)	(0.004)
Other Debt Balances	-0.012***	-0.006***	-0.011***	-0.006***
	(0.000)	(0.001)	(0.001)	(0.000)
Current Mortgage LTV	0.063***	0.071**	-0.110**	-0.062***
	(0.021)	(0.032)	(0.044)	(0.019)
Negative Equity Dummy	-0.003	0.001	0.016**	-0.008**
	(0.004)	(0.005)	(0.007)	(0.003)
Number of Borrowers	-0.031***	-0.040***	-0.038***	-0.035***
	(0.003)	(0.003)	(0.005)	(0.002)
Household Size	-0.018***	-0.021***	-0.019***	-0.022***
	(0.001)	(0.001)	(0.002)	(0.001)
Age (Primary Borrower)	0.000*	0.001***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Interest Rate Type: SVR	-0.009***	-0.018***	-0.004	-0.019***
	(0.003)	(0.006)	(0.007)	(0.004)
Interest Rate Type: Tracker	-0.106***	-0.117***	-0.067***	-0.071***
	(0.004)	(0.006)	(0.007)	(0.004)
Vintage: [2004,2006)	0.000	0.009*	0.007	0.002
	(0.003)	(0.005)	(0.006)	(0.003)
Vintage: 2006	-0.002	0.006	0.003	-0.007**
	(0.003)	(0.005)	(0.007)	(0.003)
Vintage: [2007,2009)	0.006*	0.015***	0.005	-0.003
	(0.003)	(0.005)	(0.007)	(0.003)
Vintage: [2009,2014]	0.001	0.023***	-0.002	0.002
	(0.005)	(0.006)	(0.009)	(0.004)
DPD: (90,180]	0.016***	0.020***	0.009	0.016***
	(0.003)	(0.005)	(0.006)	(0.003)
DPD: (180,365]	0.022***	0.023***	0.012**	0.011***
	(0.003)	(0.005)	(0.006)	(0.002)
DPD: (365,720]	0.026***	0.023***	0.017**	0.016***
	(0.004)	(0.005)	(0.007)	(0.003)
DPD: (720,Inf]	0.019***	0.016***	0.022**	0.022***
	(0.005)	(0.006)	(0.009)	(0.003)
Log(Mortgage Balance)	0.093***	0.089***	0.095***	0.091***
	(0.002)	(0.003)	(0.004)	(0.002)
Num Obs	16439	11002	4566	20391
R2	0.319	0.269	0.308	0.296

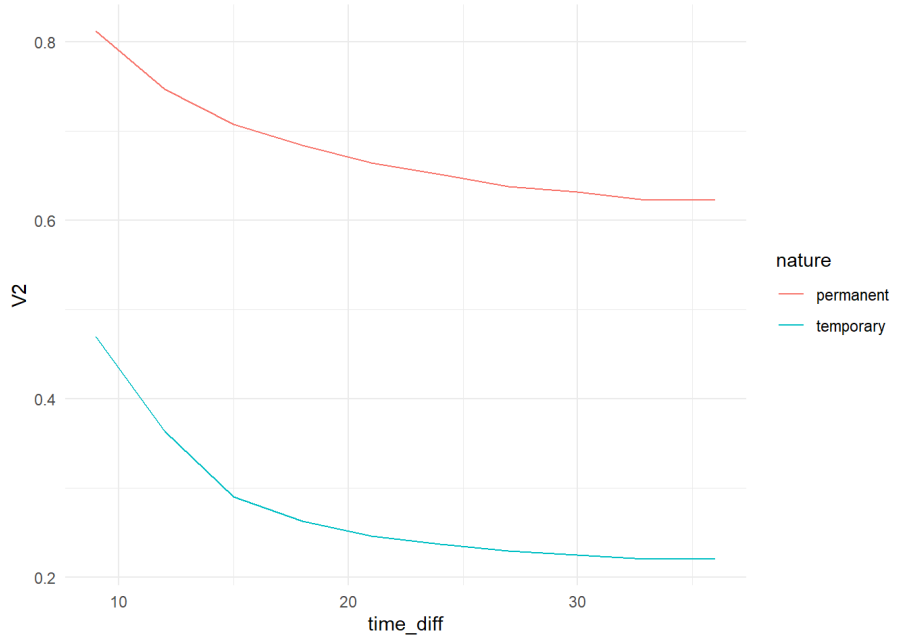
Note: Models estimated by OLS, with coefficients on quarter-of-origination, region and lender fixed effects all omitted for brevity. PTI is the ratio of post-modification mortgage repayments to net monthly household income. $RIMR$ is the ratio of residual income (income less non-mortgage outgoings) to monthly ex-ante mortgage repayments. Both $RIMR$ and Current LTV are standardised. Interest Rate Types relative to Fixed-Rate. Vintage: relative to base category of loans issued before 2004. Days Past Due (DPD) coefficients relative to loans with less than 90 days arrears. Categories refer to number of days of arrears at the point of SFS completion. Pre refers to the Pre-MART period, post the post-MART period.

Figure 11: Non-linear Effects of Residual Income



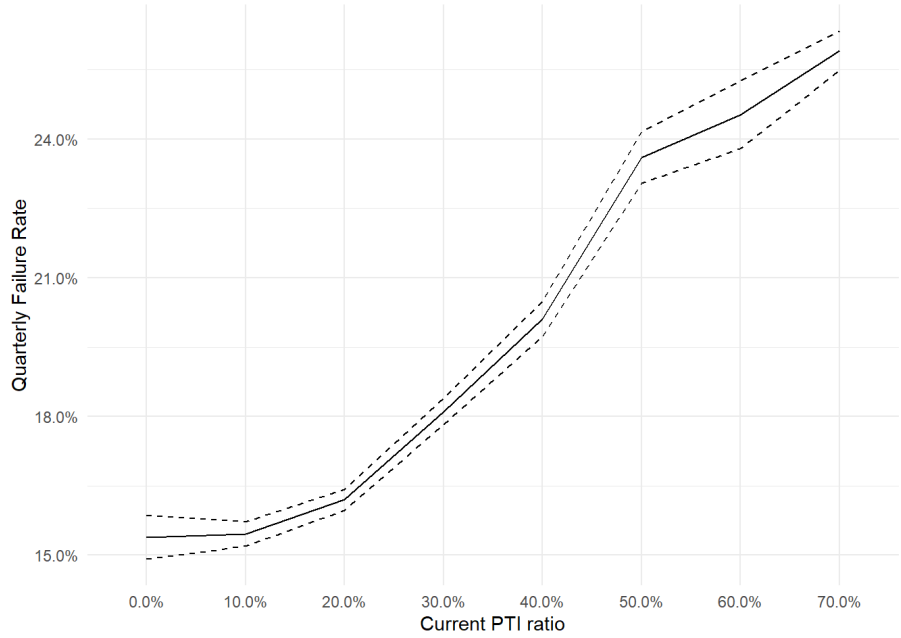
Note: Non-parametric estimates of the impact of the residual income to amortizing mortgage payment ratio on modification size and post-modification PTI, by modification type (temporary v. permanent). Estimates are the coefficient on dummies for intervals of RIMR of size 0.05 (reference category $(0, 0.05]$), controlling for the size of other debt, CLTV, negative equity, size of the household, number of kids, age of the borrower, interest rate type, vintage, delinquency status and time dummies.

Figure 12: Post-Modification Failures, across Modification Type



Note: Survival curves for modified loans, by modification type. We measure the number of months before a loan fails post modification. Failure occurs if either the borrower defaults on the loan or the lender issues a new modification for this loan.

Figure 13: Failure Rates and Payment-to-Income Levels



Note: Quarterly failure rates for modified loans, by current payment-to-income (PTI) ratio. The solid line shows the average failure rate by PTI bucket. Dashed lines show confidence intervals based on the empirical standard deviation.

Table 8: Failure Rates, All Modifications Types

	Failure	Failure	Failure	Failure	Failure	Failure	Failure
Temporary Modification	0.094***	0.087***	0.087***	0.089***	0.089***	0.095***	0.099***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Current PTI		0.083***	0.089***	0.072***		0.053***	0.049***
		(0.004)	(0.010)	(0.004)		(0.005)	(0.006)
Current PTI > 0.4			0.011**				
			(0.006)				
Current PTI x Current PTI > 0.4			-0.019				
			(0.013)				
Current LTV				0.035***	0.025**	0.139***	0.187***
				(0.011)	(0.012)	(0.013)	(0.015)
Current PTI - 0.2					0.071***		
					(0.004)		
Current PTI - 0.2 x Current LTV					0.108**		
					(0.050)		
Δ PTI						0.171***	0.158***
						(0.010)	(0.010)
Observations	181,448	177,544	177,544	170,244	170,244	125,515	118,309
R2	0.166	0.168	0.168	0.173	0.173	0.234	0.236
Controls	-	-	-	-	-	-	Yes

Note: The sample includes all mortgages reported in the Central Bank of Ireland loan-level dataset between June 2012 and June 2015 for which we can observe an SFS and that received a modification (temporary or permanent). Failure is a dummy equal to 1 if the loan is delinquent or is modified again. The loan drops out of the sample the period after failure is equal to 1. Temporary modification is a dummy for the modification to be temporary. Current PTI is the payment to income ratio at the time of observation. Current PTI > 0.4 is a dummy for current PTI to be greater than 40%. Current LTV is the loan-to-value ratio at the time of observation, standardized. Current PRI - 0.2 is current PTI minus 0.2 so that the coefficient on its interaction with current LTV can be interpreted. Delta PTI is the change in payment to income between the observation period and the previous period. Controls included but not reported in column 7: loan vintage, borrowers' expenditures, size of households, number of kids.

Table 9: Failure Rates, Permanent Modifications

	Failure	Failure	Failure	Failure	Failure	Failure	Failure
Current PTI		0.058***	0.039***	0.056***		0.056***	0.061***
		(0.006)	(0.013)	(0.006)		(0.007)	(0.008)
Current PTI > 0.4			-0.003				
			(0.009)				
Current PTI x Current PTI > 0.4			0.020				
			(0.018)				
Current LTV				0.035**	0.040***	0.131***	0.166***
				(0.014)	(0.015)	(0.016)	(0.018)
Current PTI - 0.2					0.057***		
					(0.006)		
Current PTI - 0.2 x Current LTV					-0.079		
					(0.081)		
Δ PTI						0.188***	0.175***
						(0.021)	(0.021)
Observations	79,250	78,012	78,012	74,774	74,774	58,976	55,928
R2	0.071	0.072	0.072	0.064	0.064	0.079	0.080
Add. Controls	No	No	No	No	No	No	Yes

Note: The sample includes all mortgages reported in the Central Bank of Ireland loan-level dataset between June 2012 and June 2015 for which we can observe an SFS and that received a permanent modification. Failure is a dummy equal to 1 if the loan is delinquent or is modified again. The loan drops out of the sample the period after failure is equal to 1. Temporary modification is a dummy for the modification to be temporary. Current PTI is the payment to income ratio at the time of observation. Current PTI > 0.4 is a dummy for current PTI to be greater than 40%. Current LTV is the loan-to-value ratio at the time of observation, standardized. Current PRI - 0.2 is current PTI minus 0.2 so that the coefficient on its interaction with current LTV can be interpreted. Delta PTI is the change in payment to income between the observation period and the previous period. Controls included but not reported in column 7: loan vintage, borrowers' expenditures, size of households, number of kids.

Table 10: Failure Rates, Temporary Modifications

	Failure	Failure	Failure	Failure	Failure	Failure	Failure
Current PTI		0.086***	0.115***	0.070***		0.070***	0.065***
		(0.005)	(0.015)	(0.005)		(0.007)	(0.008)
Current PTI > 0.4			0.020***				
			(0.008)				
Current PTI x Current PTI > 0.4			-0.048***				
			(0.018)				
Current LTV				0.023	0.012	0.133***	0.174***
				(0.016)	(0.018)	(0.020)	(0.024)
Current PTI - 0.2					0.069***		
					(0.006)		
Current PTI - 0.) x Current LTV					0.089		
					(0.066)		
Δ PTI						0.086***	0.073***
						(0.012)	(0.013)
Num.Obs.	10,2198	99,532	99,532	95,470	95,470	66,539	62,381
R2	0.190	0.192	0.192	0.207	0.207	0.254	0.255
Controls	-	-	-	-	-	-	Yes

Note: The sample includes all mortgages reported in the Central Bank of Ireland loan-level dataset between June 2012 and June 2015 for which we can observe an SFS and that received a temporary modification. Failure is a dummy equal to 1 if the loan is delinquent or is modified again. The loan drops out of the sample the period after failure is equal to 1. Temporary modification is a dummy for the modification to be temporary. Current PTI is the payment to income ratio at the time of observation. Current PTI > 0.4 is a dummy for current PTI to be greater than 40%. Current LTV is the loan-to-value ratio at the time of observation, standardized. Current PRI - 0.2 is current PTI minus 0.2 so that the coefficient on its interaction with current LTV can be interpreted. Delta PTI is the change in payment to income between the observation period and the previous period. Controls included but not reported in column 7: loan vintage, borrowers' expenditures, size of households, number of kids.

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